MEANDER LINE SLOT ANTENNA DESIGN FOR WLAN APPLICATION

PUTERI NUR RAIHAN BINTI NAJMULDIN

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For my beloved mother, father, family and friends.

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ABSTRACT

In wireless communication, miniaturized antennas are becoming the necessary task to achieve an optimal design so that the entire transceivers can be on a single chip thus reducing the cost. Study shows that as size decreases, the bandwidth and efficiency will also decrease. These are the fundamental limitation that becomes the major factor in antenna architecture. The objective of the project is to design, simulate and fabricate a meander line slot antenna for WLAN application at frequency 2.4 GHz. Computer Simulation Technology (CST) software is used in simulation process to simulate the return loss, gain and radiation pattern. The design is fabricated on double layer FR4 board using chemical etching technique. Then the design has been tested with Advantest Network Analyzer and Spectrum Analyzer to measure return loss, gain and radiation pattern. The simulation results show the antenna has good return loss with bandwidth 150.6 MHz and gain 4.414 dB. The measurement result shows that the return loss is similar to simulation result. The gain of fabricated antenna is higher compared to simulation gain. The measured radiation pattern is similar with simulated radiation pattern. The half power beamwidth (HPBW) for simulation is 80.9^{o} higher than measurement HPBW which is 73.7^{o}.

ABSTRAK

Dalam komunikasi tanpa wayar, antenna bersaiz kecik menjadi tugas yang perlu dilakukan untuk mencapai rekaan yang optimum supaya semua penghantar terima boleh berada diatas satu cip tunggal lalu mengurangkan kos. Kajian menyatakan bahawa apabila saiz berkurangan, jalur lebar dan kecekapan juga akan berkurangan. Ini adalah had asas yang menjadi faktor utama Objektif projek ini ialah untuk mereka, simulasi dan mengukur antena meander line slot untuk aplikasi WLAN pada frekuensi 2.4 GHz. Perisian Computer Simulation Technology (CST) digunakan untuk proses simulasi rekaan.untuk simulasi pertambahan, susut balik dan corak radiasi antena. Rekaan antena difabrikasi di atas papan dua lapis Flame Retardant 4, (FR4) dengan menggunakan teknik ukiran kimia. Rekaan kemudiannya diuji dengan menggunakan Advantest Network Analyzer dan Spectrum Analyzer untuk pengukuran pertambahan, susut balik dan corak radiasi Keputusan simulasi menunjukkan antena mempunyai nilai susut balik yang baik dengan nilai jalur lebar 150.6 MHz dan kenaikan 4.414 dB. Corak radiasi yang diukur mempunyai bentuk yang hampir sama dengan simulasi. Nilai Half Power Beamwidth (HPBW) untuk simulasi adalah 80.9^{o} lebih tinggi daripada nilai ukuran HPBW iaitu 73.7^{o}.

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LIST OF ABBREVIATIONS

T_x	-	Transmit Antenna
R_x	-	Receiver Antenna\
WLAN	-	Wireless Local Area Network
LAN	-	Local Area Network
MLA	-	Meander Line Antenna
MLSA	-	Meander Line Slot Antenna
FR4	–	Flame Resistance 4
D	-	Length of dumbbell
V	-	Width of dumbbell
N	-	Number of meander turns
a	-	Horizontal slot
b	-	Vertical Slot
W_a	-	Width of Horizontal slot
W_b	-	Width of Vertical slot
CST	-	Computer Simulation Technology
BW	-	Bandwidth
U	-	radiation intensity

$\mathbf{P_{in}}$	-	total input power
$\mathbf{f_L}$	-	highest frequency
$\mathbf{f_H}$	-	lowest frequency
D	-	directive gain
P	-	power density at some point with a given antenna
$\mathbf{P_{ref}}$	-	power density at the same point with reference antenna
D	-	directivity
$\mathbf{U_0}$	-	radiation intensity of isotropic source
$\mathbf{P_{rad}}$	-	power radiate
$\mathbf{P_R}$	-	reflected power
$\mathbf{P_T}$	-	transmitted power
HPBW	-	Half Power Beamwidth
FNBW	-	First Null Beamwidth
CW	-	clockwise
CCW	-	counter clockwise
FTD	-	Finite Time Domain
TD-TLM	-	three dimensional time-domain transmission line matrix
PCS	-	Personal Communication System
CDMA	-	code division multiple access
$\mathbf{e_1}$	-	vertical printed traces
$\mathbf{e_2}$	-	horizontal printed traces
L_{ax}	-	vertical length of antenna
PML	-	perfectly matched layers

W_s	**-**	width
t_s	**-**	thickness
e_1 and **e_2**	**-**	length of trace area
HFSS	**-**	High Frequency Structure Simulator
FEM	**-**	Finite Element Method
MOM	**-**	Method of Moment
ΔL	**-**	inductive loading effect
S	**-**	vertical length
L	**-**	the length of meander line antenna
W	-	width of microstrip feed line
A	-	constant
d	-	thickness of substrate
B	-	constant
ε_r	-	relative permittivity
Z_o	-	characteristic impedance
β	-	propagation constant
ε_e	-	effective dielectric constant
l	-	length of microstrip feed line
Ko	-	cut off wavenumber
d	-	thickness
h	-	conductor thickness
E-plane	-	horizontal plane